

Anemia of Prematurity: Controversies and evidence-based management

Arun K. Pramanik, MD

Professor of Pediatrics

LSU Health, Shreveport, LA, USA



Disclosure

Statement

No financial relationship with any entity producing, marketing, re-selling, or distributing health care goods or services that I will discuss in this presentation.



Traditional Transfusion Practice for VLBW Neonates



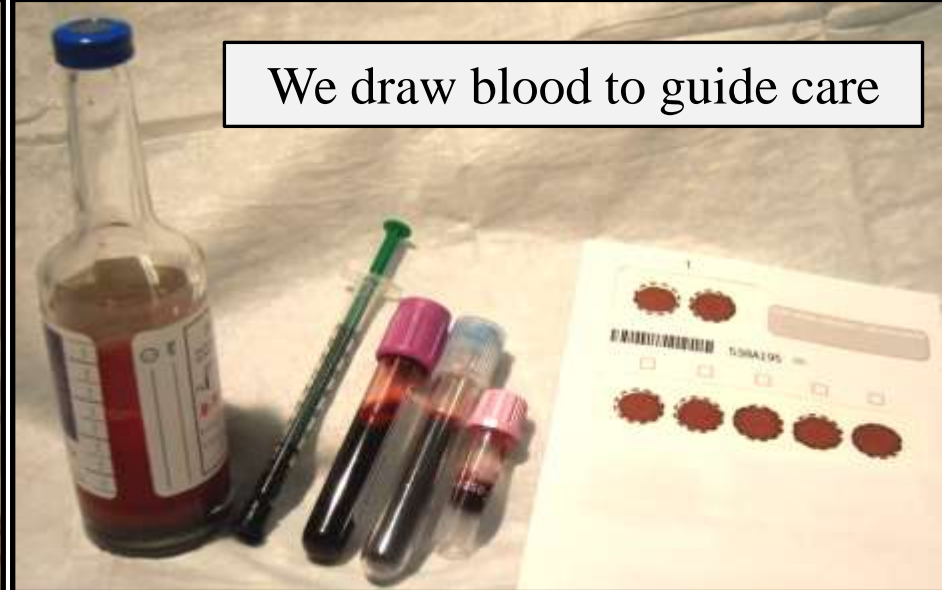
VLBW premature birth



VLBW premature birth



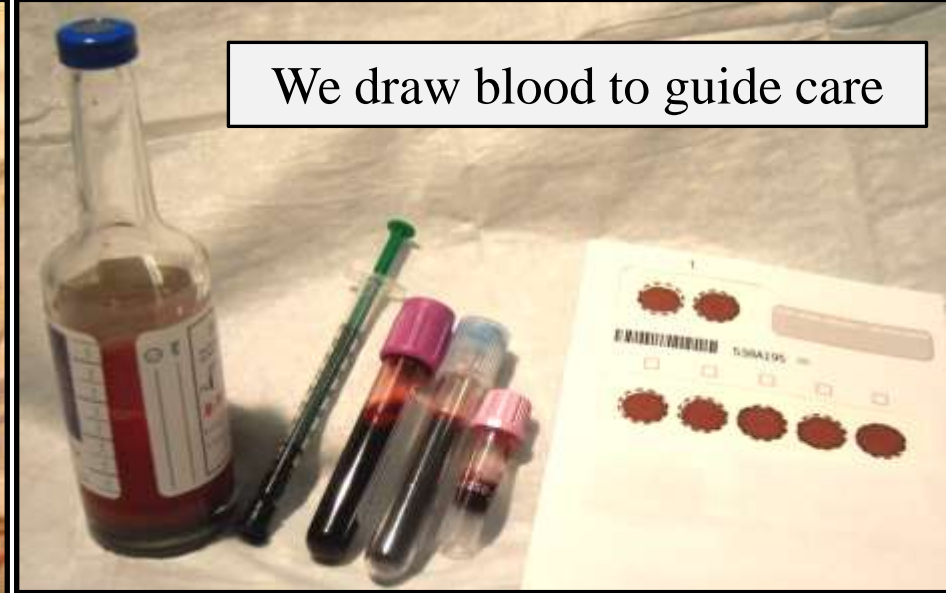
We draw blood to guide care



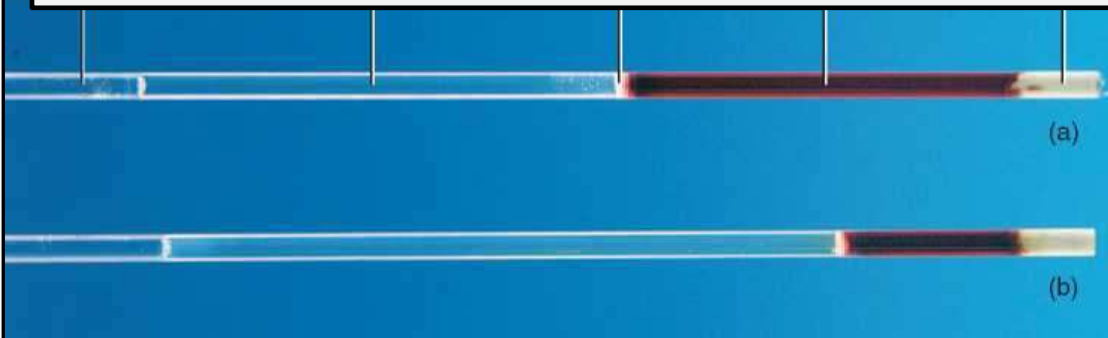
VLBW premature birth



We draw blood to guide care



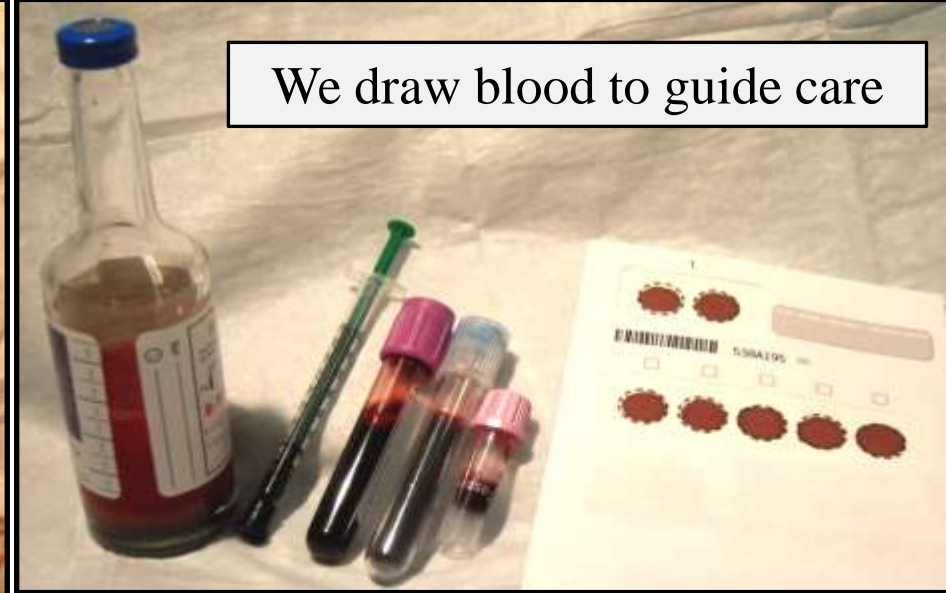
We order transfusion when criteria are met; based on blood hemoglobin concentration or hematocrit



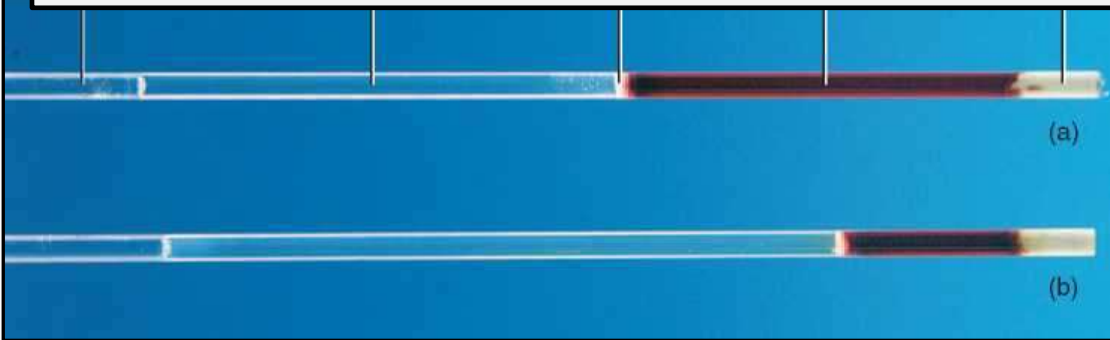
VLBW premature birth



We draw blood to guide care



We order transfusion when criteria are met; generally based on blood hgb concentration or hct



We transfuse adult donor blood



VLBW premature birth



We draw blood to guide care



So what's the big deal? Hasn't this basic paradigm worked since Neonatology began?



1. RBC transfusion of VLBW neonates (especially during their first days) is associated with risks.



1. RBC transfusion of VLBW neonates (especially during their first days) is associated with risks.
2. We can reduce those risks by implementing “transfusion avoidance” strategies that safely lower the transfusion rate.



1. RBC transfusion of VLBW neonates (especially during their first days) is associated with risks.
2. We can reduce those risks by implementing “transfusion avoidance” strategies that safely lower the transfusion rate.
3. Safely reducing the transfusion rate drops costs, preserves resources, and improves outcomes.



**Red Blood Cell Transfusions are
Independently Associated with
Intra-Hospital *Mortality* in Very Low Birth
Weight Preterm Infants** (dos Santos and the Brazilian collaborative)

- Of 1077 VLBW infants, 53% received at least one RBC transfusion. The mean number of transfusions per infant was 3.3 ± 3.4 , with 2.1 ± 2.1 in the first 28 days of life.

Red Blood Cell Transfusions are Independently Associated with Intra-Hospital Mortality in Very Low Birth Weight Preterm Infants (dos Santos and the Brazilian collaborative)

- Of 1077 VLBW infants, 53% received at least one RBC transfusion. The mean number of transfusions per infant was 3.3 ± 3.4 , with 2.1 ± 2.1 in the first 28 days of life.
- After *adjusting for confounders*, the relative risk of death was 1.5 in infants who received ≥ 1 RBC transfusions, compared with infants who did not receive a transfusion.

Red Blood Cell Transfusions are Independently Associated with Intra-Hospital Mortality in Very Low Birth Weight Preterm Infants (dos Santos and the Brazilian collaborative)

- Of 1077 VLBW infants, 53% received at least one RBC transfusion. The mean number of transfusions per infant was 3.3 ± 3.4 , with 2.1 ± 2.1 in the first 28 days of life.
- After *adjusting for confounders*, the relative risk of death was 1.5 in infants who received ≥ 1 RBC transfusions, compared with infants who did not receive a transfusion.
- Late death (>28 days) was 2 times higher in infants who received >2 transfusions.

Effects of Red Blood Cell Transfusions on the Risk of Developing Complications or Death: an Observational Study of a Cohort of VLBW Infants. (Ghiradello et al, Milan)

- Of 641 VLBW infants, 42% received at least one RBC transfusion.

Effects of Red Blood Cell Transfusions on the Risk of Developing Complications or Death: an Observational Study of a Cohort of VLBW Infants. (Ghiradello et al, Milan)

- Of 641 VLBW infants, 42% received at least one RBC transfusion.
- After *adjusting for confounders*, baseline conditions and comorbidities, composite risk [BPD, ROP, or death] correlated with number of transfusions given. > 3 transfusions OR 5.9; (2.7 – 12.6).

Effects of Red Blood Cell Transfusions on the Risk of Developing Complications or Death: an Observational Study of a Cohort of VLBW Infants. (Ghiradello et al, Milan)

- Of 641 VLBW infants, 42% received at least one RBC transfusion.
- After *adjusting for confounders*, baseline conditions and comorbidities, composite risk [BPD, ROP, or death] correlated with number of transfusions given. > 3 transfusions OR 5.9; (2.7 – 12.6).
- Speculation: RBC transfusion increases the risk for BPD/ROP because of “oxygen toxicity”; Hgb A in donor RBC transfusions releases too much O₂ to sensitive tissues.

Why do four NICUs using identical RBC transfusion guidelines have different gestational age-adjusted RBC transfusion rates? (Henry & Christensen)

- Four Intermountain Healthcare NICUs, all using the same transfusion guidelines (based on hgb/hct)



Why do four NICUs using identical RBC transfusion guidelines have different gestational age-adjusted RBC transfusion rates? (Henry & Christensen)



- Four Intermountain Healthcare NICUs, all using the same transfusion guidelines (based on hgb/hct)
- 2400 RBC transfusions. The *gest age-adjusted* RBC transf rates (tx/1000 NICU days) varied **>4 fold** between NICUs.....**why?**

Why do four NICUs using identical RBC transfusion guidelines have different gestational age-adjusted RBC transfusion rates? (Henry & Christensen)



- Four Intermountain Healthcare NICUs, all using the same transfusion guidelines (based on hgb/hct)
- 2400 RBC transfusions. The *gest age-adjusted* RBC transf rates (tx/1000 NICU days) varied **>4 fold** between NICUs.....**why?**
- 99% of transfusion in all four NICUs were compliant with guidelines.

Why do four NICUs using identical RBC transfusion guidelines have different gestational age-adjusted RBC transfusion rates? (Henry & Christensen)



- Four Intermountain Healthcare NICUs, all using the same transfusion guidelines (based on hgb/hct)
- 2400 RBC transfusions. The *gest age-adjusted* RBC transf rates (tx/1000 NICU days) varied **>4 fold** between NICUs.....**why?**
- 99% of transfusion in all four NICUs were compliant with guidelines.
- The two low-transfusing NICUs had “anemia-preventing strategies” that the high RBC transfusion NICUs did not.

Why do four NICUs using identical RBC transfusion guidelines have different gestational age-adjusted RBC transfusion rates? (Henry & Christensen)



- Four Intermountain Healthcare NICUs, all using the same transfusion guidelines (based on hgb/hct)
- 2400 RBC transfusions. The *gest age-adjusted* RBC transf rates (tx/1000 NICU days) varied **>4 fold** between NICUs.....**why?**
- 99% of transfusion in all four NICUs were compliant with guidelines.
- The two low-transfusing NICUs had “anemia-preventing strategies” that the high RBC transfusion NICUs did not.
- NEC(≥ 2) & IVH(≥ 3) were lowest in the 2 low-transfusing NICUs ($p < 0.0002$).

So how do we decide which “**anemia-preventing strategies**” should be initiated in neonatology?



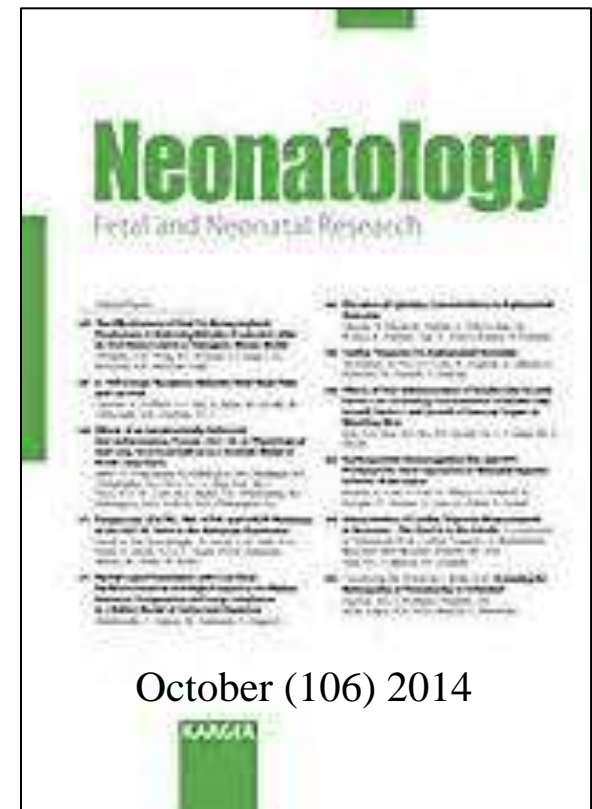
By a vote?



Evidence-Based Advances in Transfusion Practice in Neonatal Intensive Care Units

Robert D. Christensen, MD ■ Patrick D. Carroll MD ■
Cassandra D. Josephson MD ■

Intermountain Healthcare & University of Utah Salt Lake City, Utah, & Center for Transfusion & Cellular Therapies, Emory University, Atlanta, Georgia



EVIDENCE-BASE

1. Analytical methods used.
2. Delayed cord clamping at VLBW delivery.
3. Umbilical cord milking (stripping) at VLBW delivery.
4. Drawing all initial laboratory blood tests of VLBW neonates using fetal blood in the cord/placenta, thereby drawing no blood initially from the neonate.
5. Limiting phlebotomy losses of VLBW neonates in the first days after birth.
6. Administering an erythropoiesis-stimulating agent



Agency for Healthcare Research and Quality

Advancing Excellence in Health Care www.ahrq.gov

The image shows the logo for the Agency for Healthcare Research and Quality (AHRQ). It features a stylized eagle with red, black, and blue wings on the left. To the right, the acronym "AHRQ" is written in a bold, purple font with a rainbow arc above it. Below the acronym, the full name "Agency for Healthcare Research and Quality" is written in a purple, italicized font. At the bottom, the tagline "Advancing Excellence in Health Care" is written in a blue font, followed by the website address "www.ahrq.gov" in a white font on a blue background.

Categories for **grading evidence**, based the United States Preventive Services Task Force, U.S. Department of Health and Human Services' Agency for Healthcare Research and Quality

CATEGORY OF EVIDENCE

- | | |
|-----------|--|
| 1A | Meta-analysis of randomized clinical trials (RCT) |
| 1B | At least one RCT |
| 2A | At least one controlled study without randomization |
| 2B | At least one quasi-experimental study |
| 3 | Descriptive studies, such as comparative, correlation or case-control studies |
| 4 | Expert committee reports or opinions and/or clinical experience of respected authorities |

CERTAINTY of BENEFIT is judged as HIGH when consistent results are found from well-designed, well conducted studies in representative populations. MODERATE indicates evidence of a likely benefit but confidence in the estimate of effect size is diminished by few or inadequate studies. More information is needed. LOW indicates insufficient evidence to assess an effect on health outcomes.

RECOMMENDATION				
CERTAINTY OF NET BENEFIT	MAGNITUDE OF NET BENEFIT			
	Substantial	Moderate	Small	Zero/Negative
High	A	B	C	D
Moderate	B	B	C	D
Low	I			

Categories for **formulating a recommendation**, based the United States Preventive Services Task Force, U.S. Department of Health and Human Services' Agency for Healthcare Research and Quality

RECOMMENDATION

CERTAINTY OF NET BENEFIT

MAGNITUDE OF NET BENEFIT

	Substantial	Moderate	Small	Zero/Negative
High	A	B	C	D
Moderate	B	B	C	D
Low	I			

High

A

B

C

D

Moderate

B

B

C

D

Low

I

MAGNITUDE of BENEFIT is judged by statistics such as number needed to treat, number needed to screen, and number treated to result in 1 adverse health event. The last category, D, indicates that the recommendation, if enacted, is expected to achieve no net benefit or to result in overall harm.

RECOMMENDATION				
CERTAINTY OF NET BENEFIT	MAGNITUDE OF NET BENEFIT			
	Substantial	Moderate	Small	Zero/Negative
High	A	B	C	D
Moderate	B	B	C	D
Low	I			

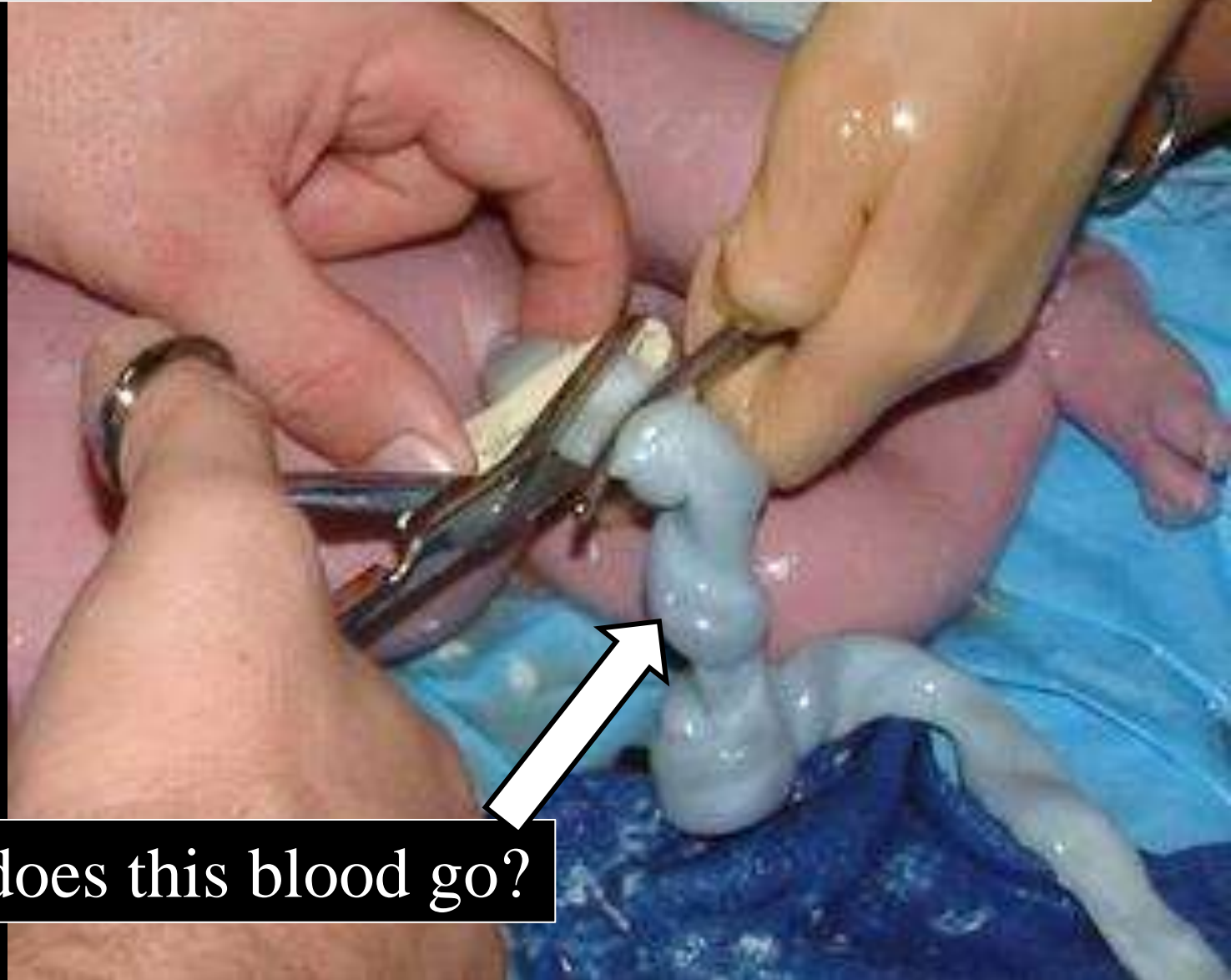
EVIDENCE-BASE

1. Analytical methods used
2. Delayed cord clamping at VLBW delivery
3. Umbilical cord milking (stripping) at VLBW delivery
4. Drawing all initial laboratory blood tests of VLBW neonates using fetal blood in the cord/placenta, thereby drawing no blood initially from the neonate
5. Limiting phlebotomy losses of VLBW neonates in the first days after birth
6. Administering an erythropoiesis-stimulating agent

Why do we typically clamp/cut the umbilical cord *immediately* after birth?

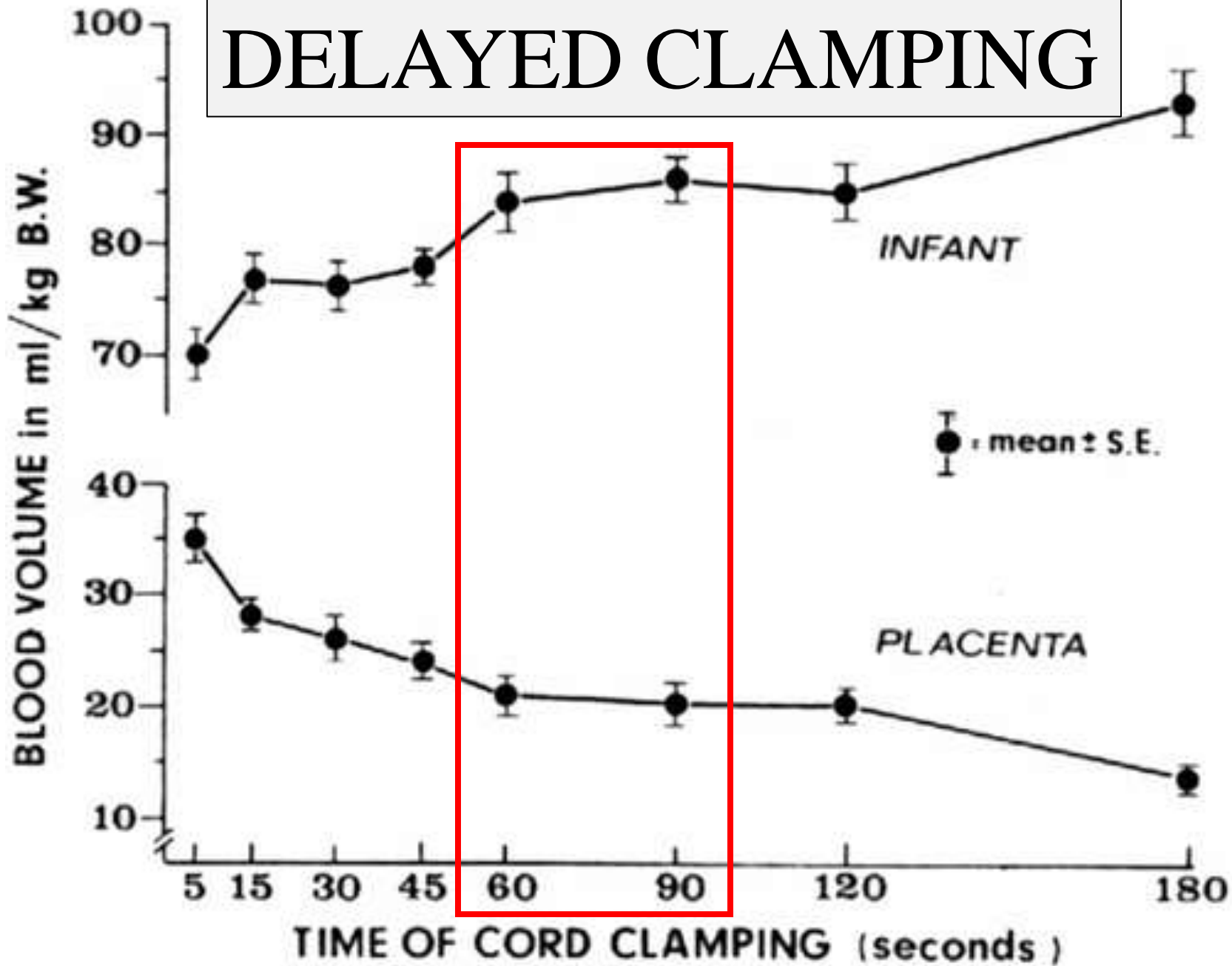


Why do we typically clamp/cut the umbilical cord *immediately* after birth?



So where does this blood go?

DELAYED CLAMPING



DELAYED CORD CLAMPING AT VLBW DELIVERY

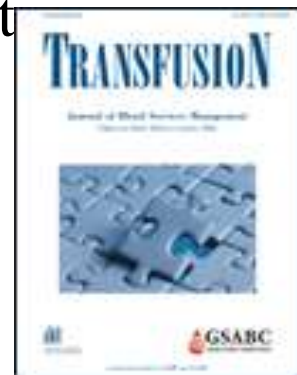
Early vs delayed umbilical cord clamping in preterm infants.
Rabe H, Reynolds G, Diaz-Rossello J. Cochrane Database
Syst Rev. 2012;8:CD003248.



Placental transfusion strategies in very preterm neonates: a
systematic review and meta-analysis. Backes CH, Rivera
BK, Haque U, Bridge JA, Smith CV, Hutchon DS, Mercer
JS. Obstet Gynecol. 2014 Jul;124(1):47-56. doi:
10.1097AOG.



Effects of placental transfusion in extremely low birthweight
infants: meta-analysis of long- and short-term outcomes.
Ghavam S, Batra D, Mercer J, Kugelman A, Hosono S, Oh
W, Rabe H, Kirpalani H. Transfusion. 2014;54(4):1192-8



ANEMIA- PREVENTING STRATEGIES FOR VLBW NEONATES	CATEGORY OF EVIDENCE	CERTAINTY / MAGNITUDE / RECOMMENDATION
Delayed clamping of the umbilical cord	1A	High/Substantial/A

EVIDENCE-BASE

1. Analytical methods used
2. Delayed cord clamping at VLBW delivery
3. Umbilical cord milking (stripping) at VLBW delivery
4. Drawing all initial laboratory blood tests of VLBW neonates using fetal blood in the cord/placenta, thereby drawing no blood initially from the neonate
5. Limiting phlebotomy losses of VLBW neonates in the first days after birth
6. Administering an erythropoiesis-stimulating agent

Many obstetricians & neonatologists have been uncomfortable delaying cord clamping, in VLBW deliveries, because of the desire to quickly hand-off the small neonate to the NICU resuscitation team.



A more rapid alternative to delayed cord clamping was proposed in 2008 – umbilical cord “milking”.



Placental End

CORD MILKING



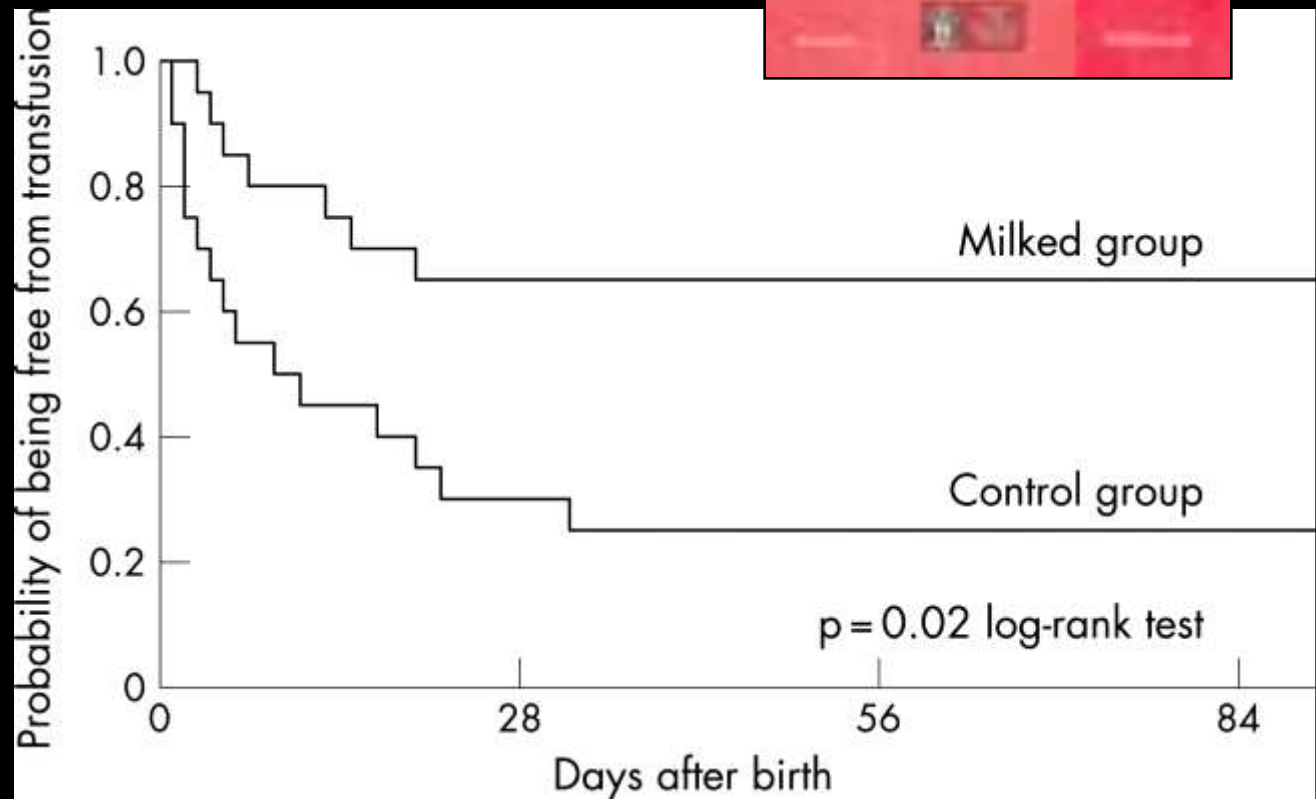
Baby End

Dr. Hosono,
Dept. Pediatrics,
Nihon University,
Tokyo, Japan

Fetal
Neonatal



Umbilical cord “milking”
reduces the need for red cell
transfusions in VLBW
neonates. *Tokyo, 2008*



In December 2012, the American College of Obstetricians and Gynecologists published a Committee Opinion entitled "Timing of umbilical cord clamping after birth." It stated that "evidence exists to support delayed cord clamping in preterm infants, when feasible. The single most important benefit for preterm infants is the possibility for a nearly 50% reduction in IVH."

Additional study is needed on "cord milking".



CORD MILKING AT VLBW DELIVERY REPORTS SINCE 2014

Umbilical cord milking improves transition in premature infants at birth.

Katheria A, Blank D, Rich W, Finer N. PLoS One. 2014;7;9(4):e94085



Effect of umbilical cord milking on the need for PRBC transfusions and early neonatal hemodynamic adaptation in preterm infants <1500 g: A prospective, randomized, controlled trial. Alan S, Arsan S, Okulu E, et al. J Pediatr Hematol Oncol. 2014;36(8):e493-8



The effects of umbilical cord milking on hemodynamics and neonatal outcomes in premature neonates. Katheria AC, Leone TA, Woelkers D, Garey DM, Rich W, Finer NN. J Pediatr. 2014;164(5):1045-1050.e1.



Effects of placental transfusion in ELBW infants: meta-analysis of long and short-term outcomes. Ghavam S, Batra D, Mercer J, Kugelman A, Hosono S, Oh W, Rabe H, Kirpalani H. Transfusion. 2014;54(4):1192-8.



Whole-blood viscosity in the neonate: effects of gestational age, hematocrit, mean corpuscular volume and umbilical cord milking. Christensen RD, Baer VL, Oh W et al. J Perinatol. 2014;34(1):16-21



CORD MILKING AT VLBW DELIVERY REPORTS SINCE 2014

Effect of umbilical cord milking on morbidity and survival in extremely low gestational age neonates. Patel, Yoder *et al.* University of Utah. Am J Ob Gyn 2014;211:519.e1-7 *With Cord Milking @ <30 wks gestation:*

- First day hematocrit higher (50% vs 45%, $P < 0.01$)
- RBC transfusions fewer (57% vs 79%, $P < 0.01$)
- Reductions in IVH, NEC, and death (all $P < 0.05$).

Optimizing Care of the Preterm Infant Starting in the Delivery Room. Katheria, Rich, Finer. Am J Perinatol Jan 5 2016, [Epub ahead of print]. Delayed cord clamping and cord milking provide significant benefits when compared with immediate cord clamping.

Neurodevelopmental Outcomes at 2 and 3.5 Years for Very Preterm Babies Enrolled in a Randomized Trial of Milking the Umbilical Cord vs Delayed Cord Clamping. Rabe *et al.* Neonatology 2015 Dec 10;109(2):113-119. Followed up at 2 and 3.5 years of age, milking of the cord 4 times did not have any long-term adverse effect on neurodevelopmental outcome, suggesting that cord milking could be used as an alternative to delayed cord clamping.

Umbilical Cord Milking Versus Delayed Cord Clamping in Preterm Infants. Katheria, Truong, Cousins, Oshiro, Finer. Pediatrics 2015;136(1):61-9. The first randomized controlled trial demonstrating higher systemic blood flow with cord milking in preterm neonates compared with delayed clamping. Milking may be a **more efficient** technique to improve blood volume in premature infants.



ANEMIA- PREVENTING STRATEGIES FOR VLBW NEONATES	CATEGORY OF EVIDENCE	CERTAINTY/ MAGNITUDE/ RECOMMENDATION
Delayed clamping of the umbilical cord	1A	High/Substantial/A
Milking the umbilical cord	1A	High/Substantial/A

EVIDENCE-BASE

1. Analytical methods used
2. Delayed cord clamping at VLBW delivery
3. Umbilical cord milking (stripping) at VLBW delivery
4. Drawing all initial laboratory blood tests of VLBW neonates using fetal blood in the cord/placenta, thereby drawing no blood initially from the neonate
5. Limiting phlebotomy losses of VLBW neonates in the first days after birth
6. Administering an erythropoiesis-stimulating agent

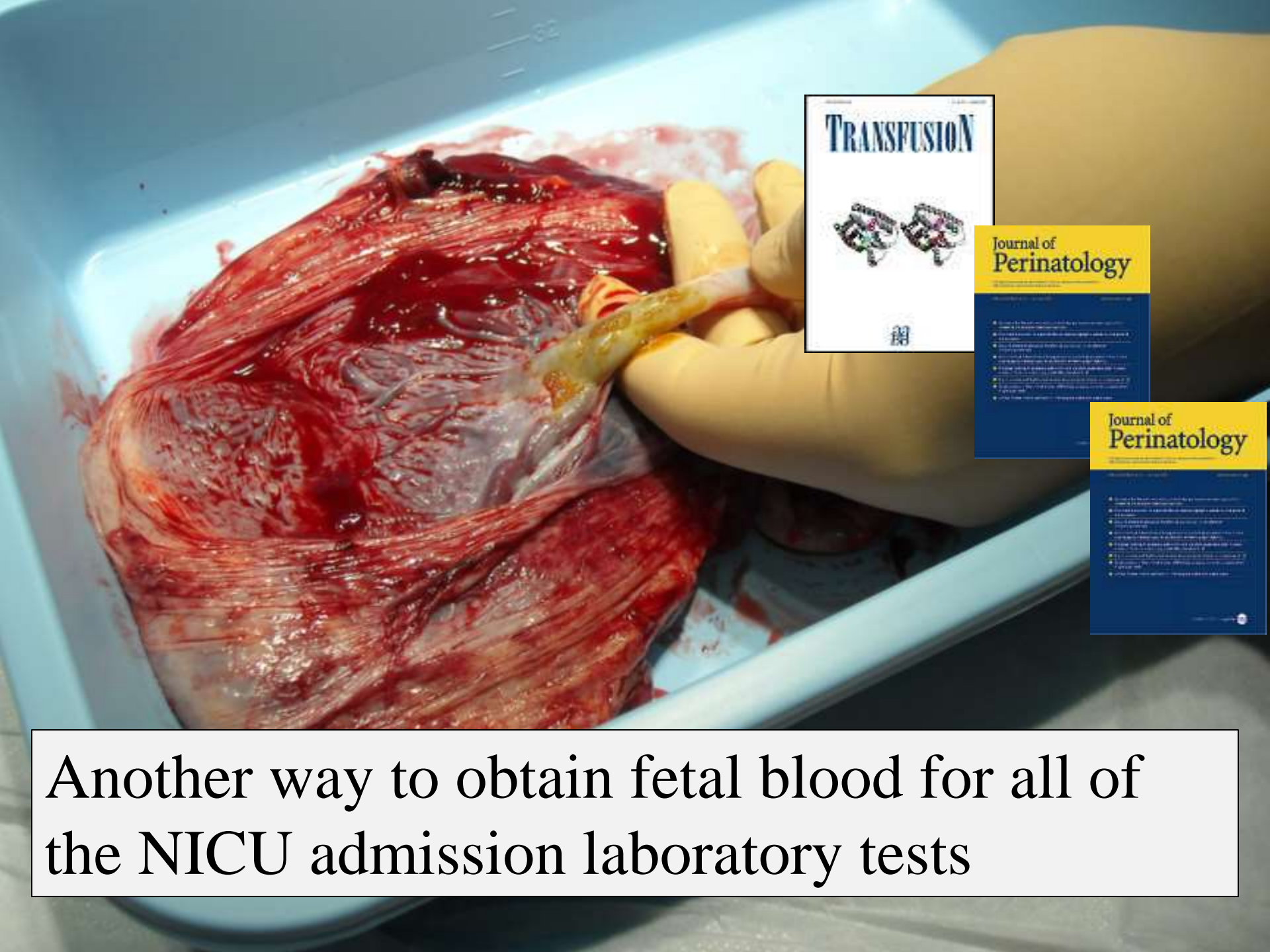
Blood tests upon NICU admission: Blood culture, CBC with differential count and platelets, state metabolic screen, other tests (blood type, Coombs, coagulation profile)





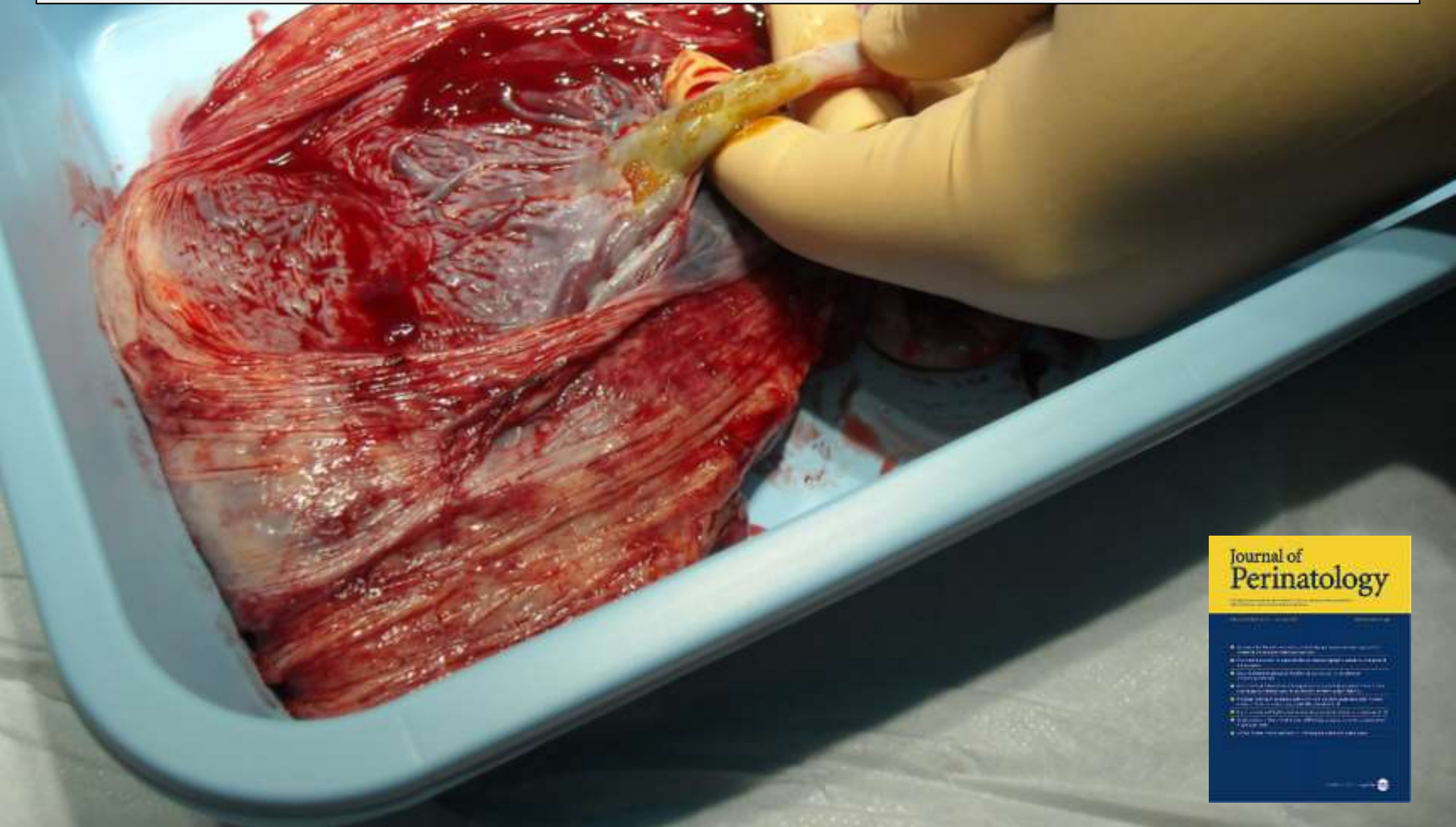


Another way to obtain fetal blood for all of the NICU admission laboratory tests

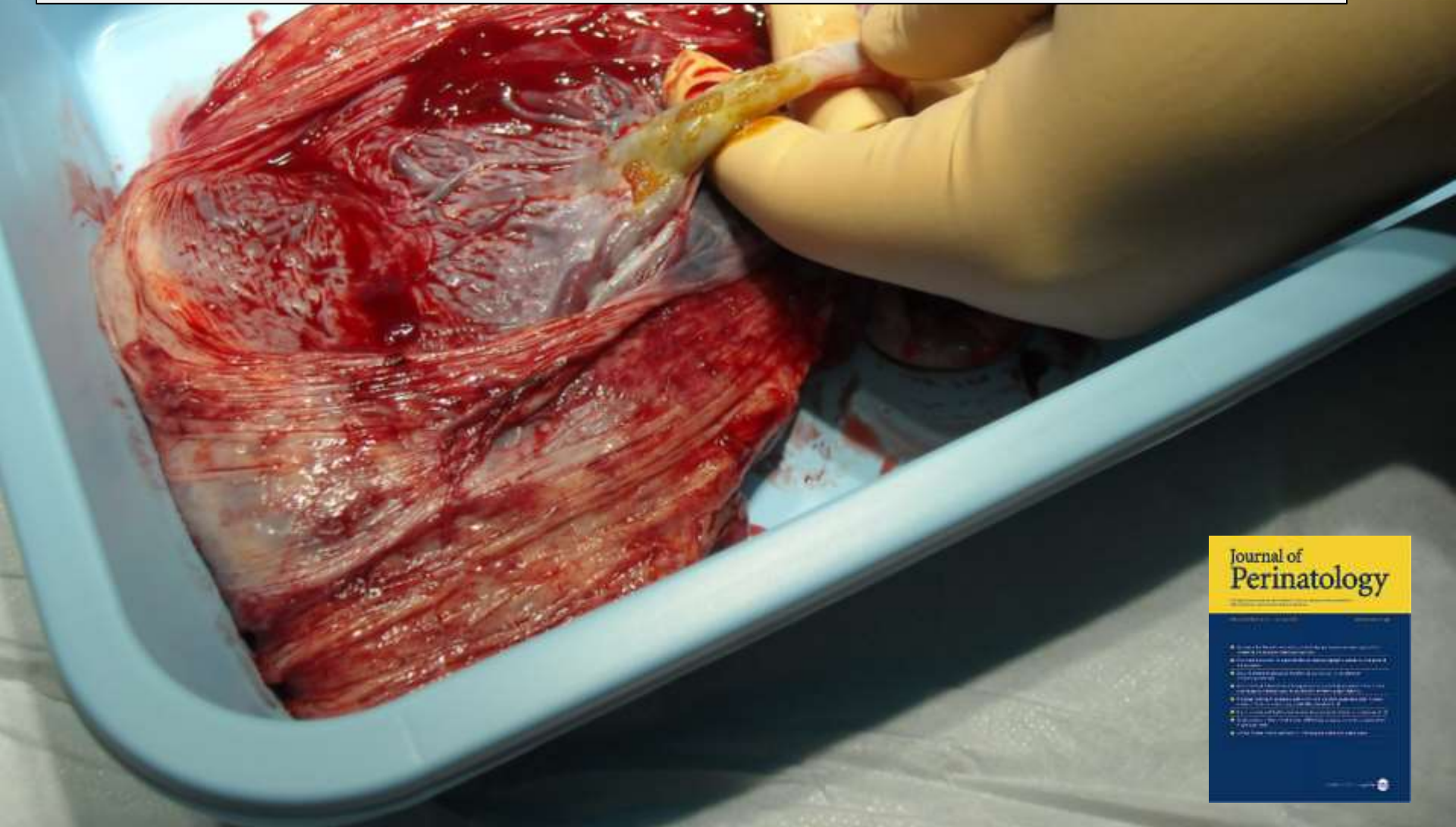


Another way to obtain fetal blood for all of the NICU admission laboratory tests

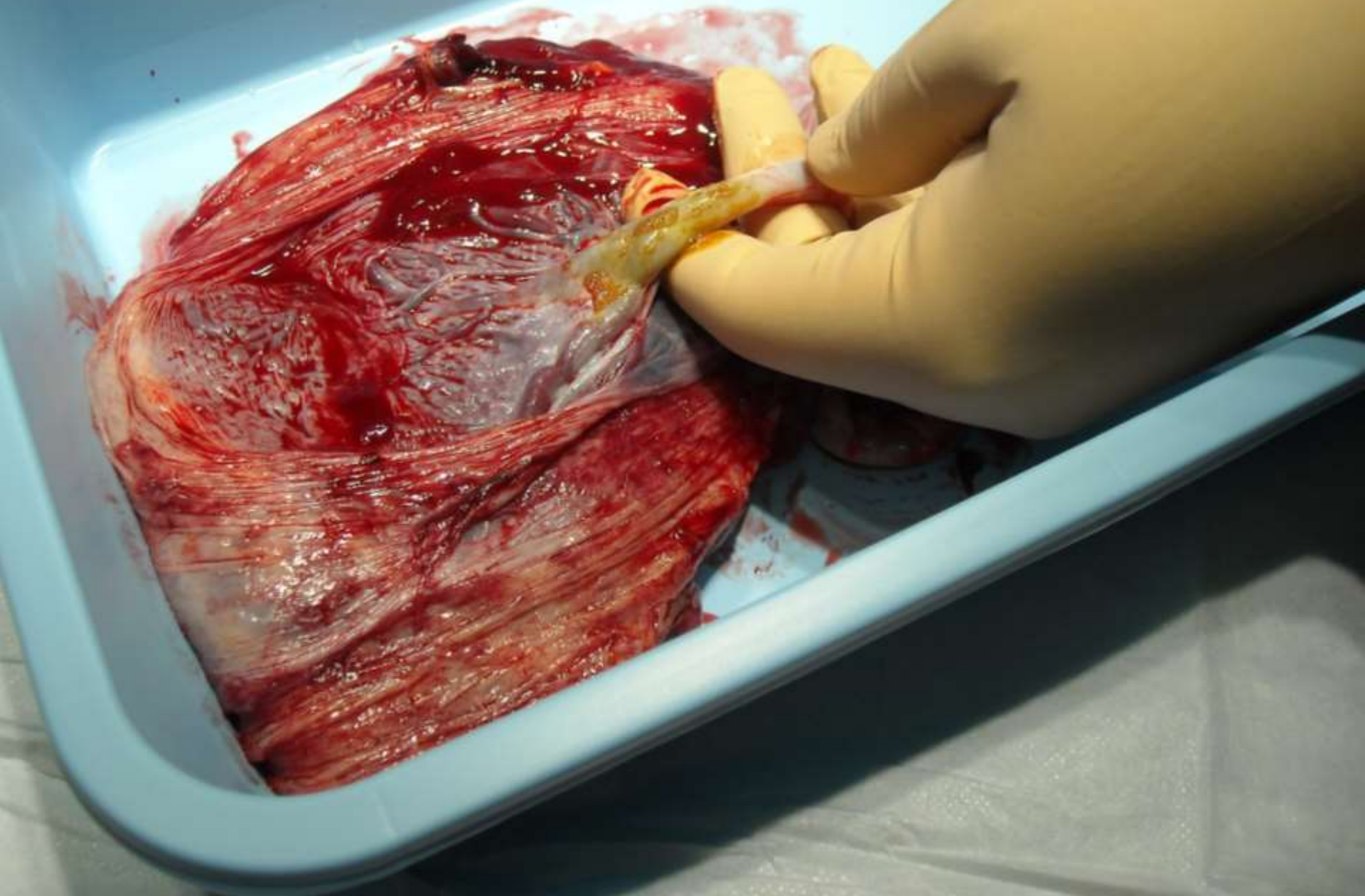
PROSPECTIVE STUDY: All baseline blood tests obtained from the umbilical vein in 100 VLBW neonates, matched with 100 drawn in the standard way (from the neonate).

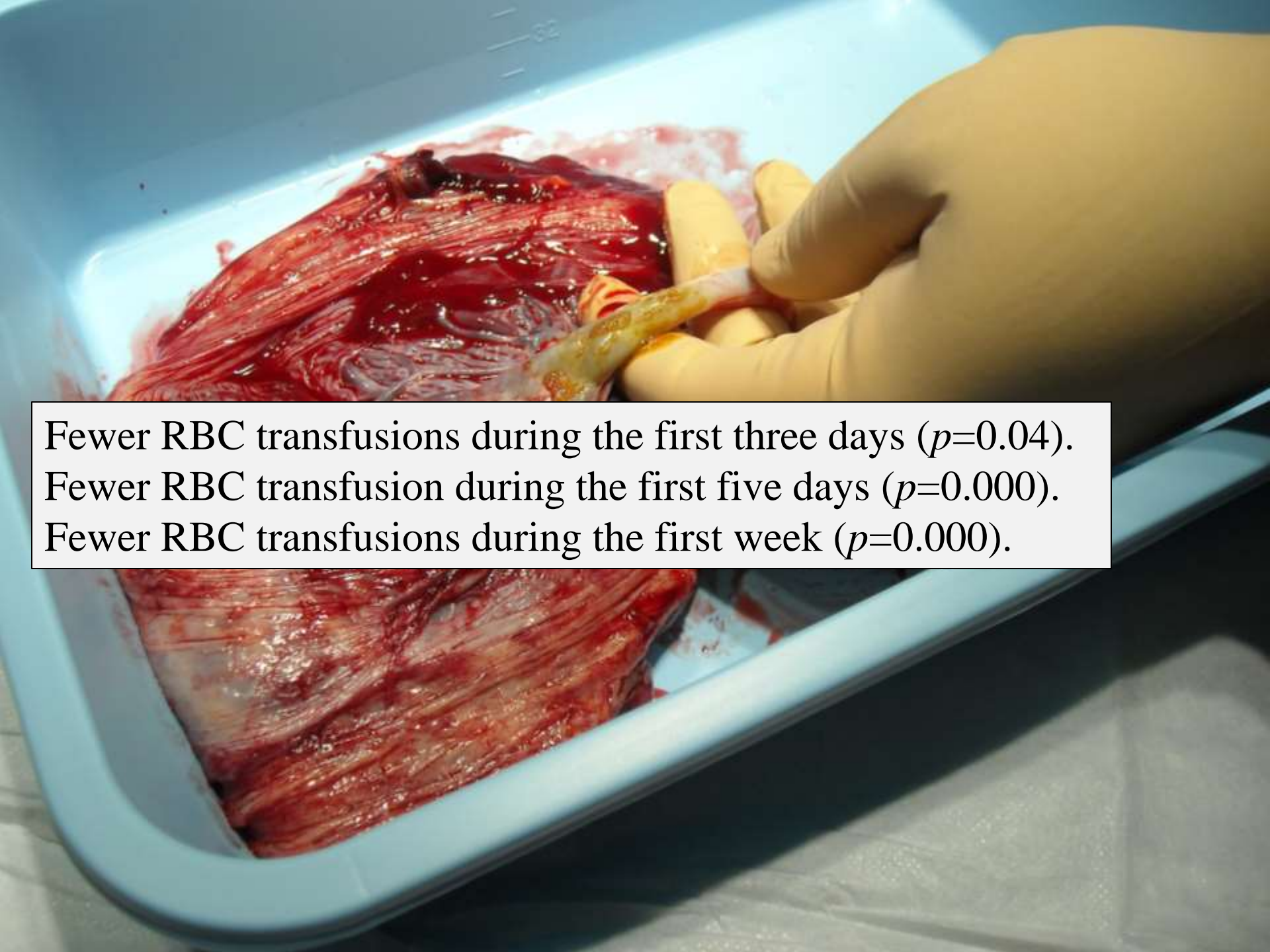


- Feasible in actual practice (Ogden, Provo, St. George)
- 95% of attempts were successful
- Successfully drawn even at 23 weeks gestation



Higher hemoglobin 24 hrs after birth (2.5 ± 0.4 g/dL, $p=0.000$)

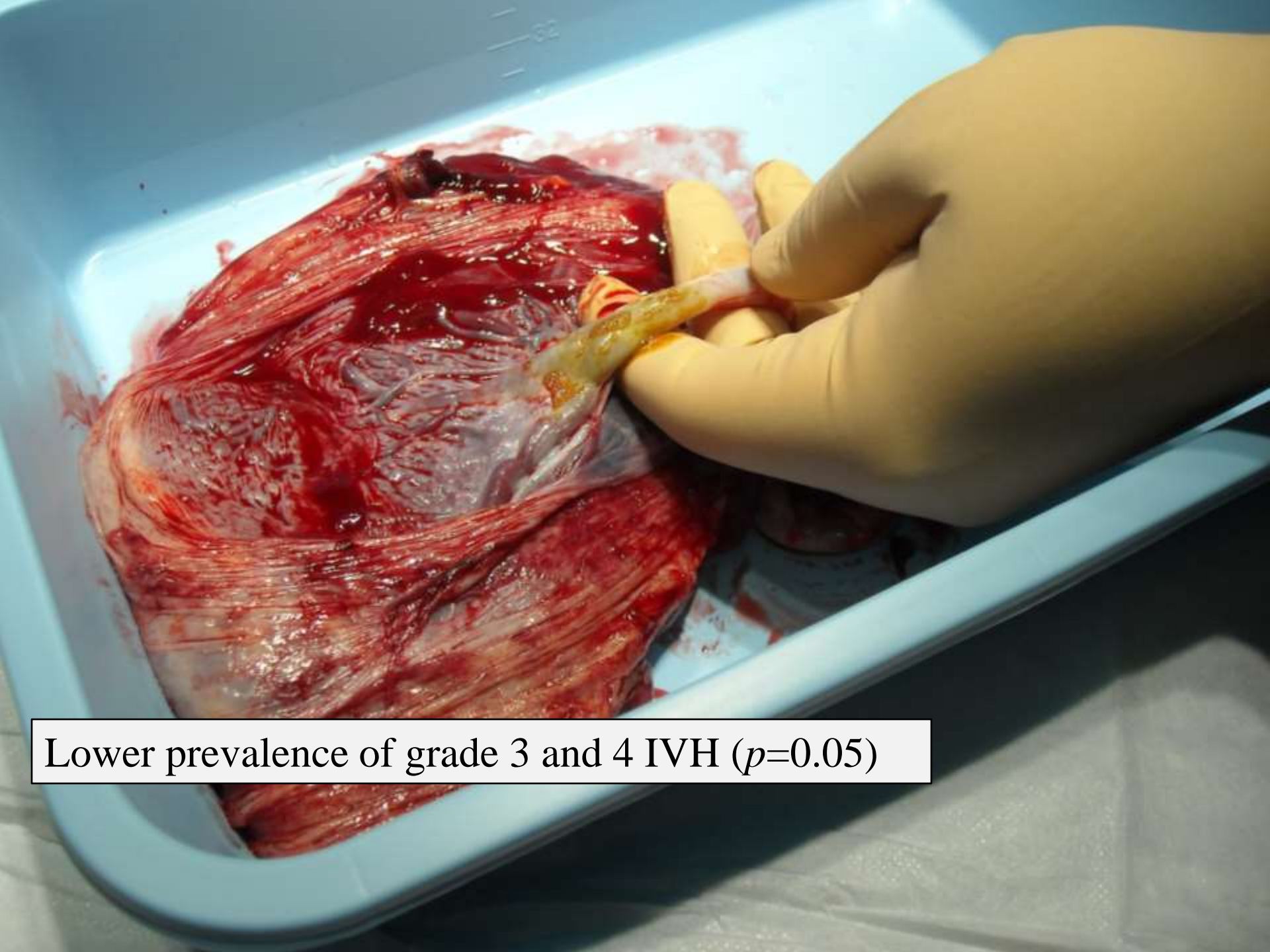




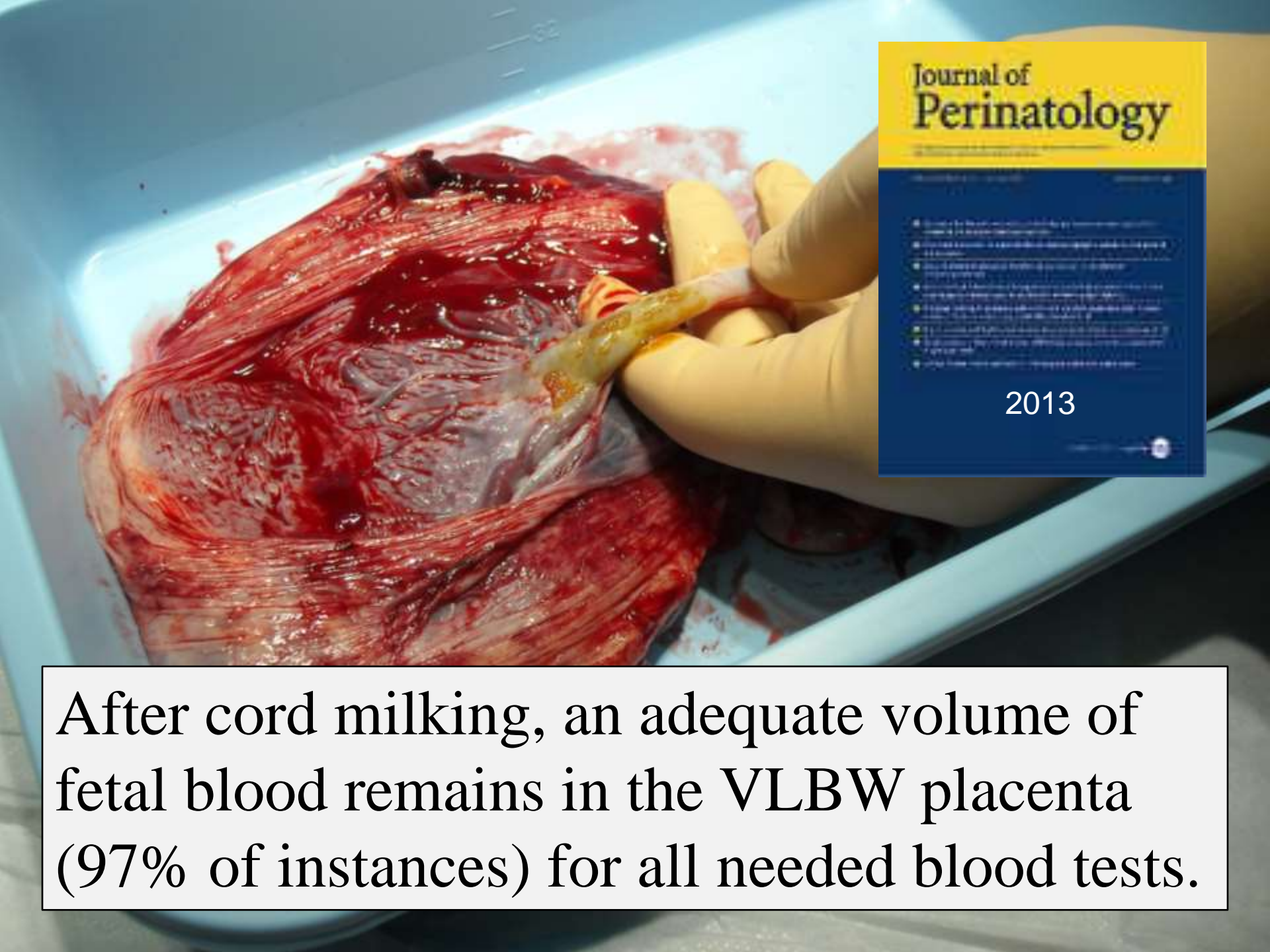
Fewer RBC transfusions during the first three days ($p=0.04$).
Fewer RBC transfusion during the first five days ($p=0.000$).
Fewer RBC transfusions during the first week ($p=0.000$).



Less use of vasopressors for hypotension ($p < 0.001$)



Lower prevalence of grade 3 and 4 IVH ($p=0.05$)



After cord milking, an adequate volume of fetal blood remains in the VLBW placenta (97% of instances) for all needed blood tests.

Best Evidence: @ VLBW delivery
cord milking or delayed clamping –

- Reduces early RBC transfusions
- Maintains more normal BP
- Reduces odds of IVH
- Does not cause hyperviscosity

Blood Viscosity (THICKNESS) can be measured in the laboratory using an instrument called a “CONE AND PLATE VISCOMETER”



ANEMIA- PREVENTING STRATEGIES FOR VLBW NEONATES	CATEGORY OF EVIDENCE	CERTAINTY / MAGNITUDE / RECOMMENDATION
Delayed clamping of the umbilical cord	1A	High/Substantial/A
Milking the umbilical cord	1A	High/Substantial/A
Drawing initial blood tests from cord	2B	Moderate/Moderate/B

EVIDENCE-BASE

1. Analytical methods used
2. Delayed cord clamping at VLBW delivery
3. Umbilical cord milking (stripping) at VLBW delivery
4. Drawing all initial laboratory blood tests of VLBW neonates using fetal blood in the cord/placenta, thereby drawing no blood initially from the neonate
- 5. Limiting phlebotomy losses of VLBW neonates in the first days after birth**
6. Administering an erythropoiesis-stimulating agent

Kling *et al.* ARCH PEDIATR ADOLESC MED 1997. In VLBW neonates, phlebotomy loss was the best predictor of transfusion requirement.



Rosenbraugh *et al.* TRANSFUSION 2013. Only **33%** of phlebotomy loss of VLBW infants was instrument required, the remaining **67%** was waste or hidden blood loss. 50% decrease in transfusions by eliminating excess phlebotomy loss beyond that of instrument requirements.



33%



67%



Valieva *et al.* J PEDIATRICS 2009. Point of care testing decreased transfusion by 43% without a change in the number of tests done.



Widenss *et al.* PEDIATRICS 2005. Reduced RBC transfusions by 33% in the first week of life using an in-line blood gas and chemistry monitor.



Decreasing phlebotomy loss is one of the most effective means of decreasing RBC transfusion of VLBW neonates

ANEMIA-PREVENTING STRATEGIES FOR VLBW NEONATES	CATEGORY OF EVIDENCE	CERTAINTY / MAGNITUDE / RECOMMENDATION
Delayed clamping of the umbilical cord	1A	High/Substantial / A
Milking the umbilical cord	1A	High/Substantial / A
Drawing initial blood tests from cord	2B	Moderate/Moderate / B
Limiting phlebotomy losses	1B	Moderate/Substantial/B

EVIDENCE-BASE

1. Analytical methods used
2. Delayed cord clamping at VLBW delivery
3. Umbilical cord milking (stripping) at VLBW delivery
4. Drawing all initial laboratory blood tests of VLBW neonates using fetal blood in the cord/placenta, thereby drawing no blood initially from the neonate
5. Limiting phlebotomy losses of VLBW neonates in the first days after birth
6. Administering an erythropoiesis-stimulating agent



A randomized, masked placebo-controlled study of darbepoetin in preterm infants. Ohls RK, Christensen RD, et al. 2013

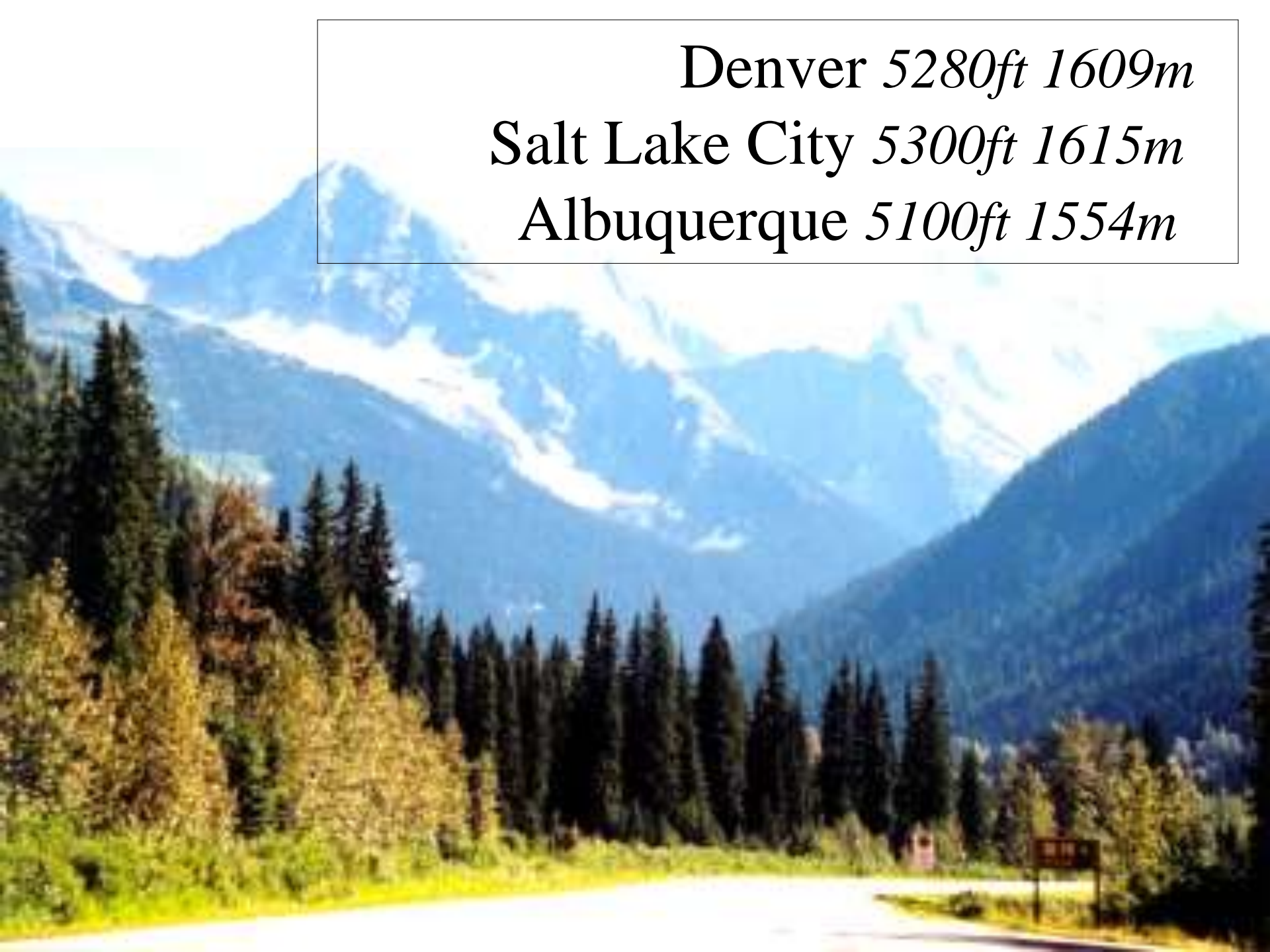


Cognitive outcomes of preterm infants randomized to darbepoetin, epo, or placebo. Ohls RK, Kamath-Rayne BD, Christensen RD, et al. 2014



Preschool assessment of preterm infants treated with darbepoetin and epo. Ohls et al. 2016





Denver *5280ft 1609m*
Salt Lake City *5300ft 1615m*
Albuquerque *5100ft 1554m*

Neurodevelopmental Outcomes at 18-22 Months

	Cognitive Scores* (Mean/SD)	Cerebral Palsy (# infants)
Darbe group (n=27)	98±8	0
Epo group (n=28)	97±14	0
Placebo (n=23)	89±14	5
Darbe & Epo vs. Placebo	$P = 0.02$	$P = 0.002$

*Bayley Scale of Infant Development (BSID III)

Neurodevelopmental Outcomes at 18-22 Months

Object Permanence*
(Measure of early working memory)

Darbe vs. Epo group

$P = 0.05$

Darbe & Epo vs. Placebo

$P = 0.01$

*Bayley Scale of Infant Development (BSID III)

Neurodevelopmental Outcomes at 4-Years

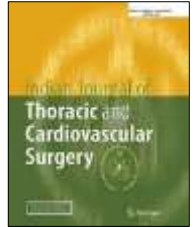
	Full scale IQ (Mean/SD)	Performance IQ (Mean/SD)
ESA (n=39)	91±17	93±17
Placebo (n=14)	79±18	79±19
ESA vs. Placebo	<i>P</i> = 0.03	<i>P</i> = 0.01

Neuroprotective effect of “early” darbepoetin (or EPO) in VLBW neonates

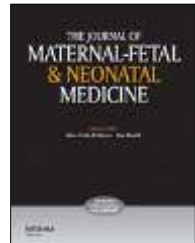
Feasibility and safety of erythropoietin for neuroprotection after perinatal arterial stroke. Benders MJ, et al. J Pediatr. 2014 164(3):481-6.e1-2.



Erythropoietin neuroprotection in neonatal cardiac surgery; a phase I/II safety and efficacy trial. Andropoulos DB, Brady K, Easley RB, et al. J Thorac Cardiovasc Surg. 2013;146(1):124-31.



Neuroprotective role of erythropoietin in neonates. Juul S. J Matern Fetal Neonatal Med. 2012;25 Suppl 4:105-7



Erythropoietin concentrations after early short-term infusion of high-dose recombinant epo for neuroprotection in preterm neonates. Dame C, Langer J, Koller BM, et al Neonatology. 2012;102:172-7.



Preterm EPO Neuroprotection Trial (PENUT Trial) NCT01378273

Darbe Administration in Newborns Undergoing Cooling for Encephalopathy (DANCE Trial) Pediatr Res 2015; Sept 78:315-22



EDITORIAL

RK Ohls, RD Christensen, JA Widness, SE Juul

Ample evidence indicates that administering ESAs to selected neonatal populations significantly diminishes transfusion requirements and blood donor exposures, reduces transfusion costs, and conserves blood bank resources.

Mounting evidence supports the hypothesis that ESAs can be neuroprotective and might improve long term neurodevelopmental outcomes of selected preterm infants. All the data of which we are aware, including the Fauchere study in this issue, indicate that early Epo administration to preterm neonates does not increase their risk for developing ROP.

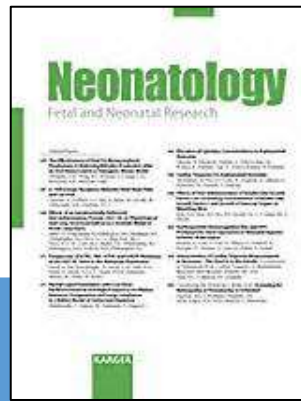


ANEMIA-PREVENTING STRATEGIES FOR VLBW NEONATES	CATEGORY OF EVIDENCE	CERTAINTY / MAGNITUDE / RECOMMENDATION
Delayed clamping of the umbilical cord	1A	High/Substantial / A
Milking the umbilical cord	1A	High/Substantial / A
Drawing initial blood tests from cord	2B	Moderate/Moderate / B
Limiting phlebotomy losses	1B	Moderate/Substantial/ B
Erythropoietin/ Darbepoetin	1A	Moderate/Moderate/B Moderate/Small/ C

Many Remaining Questions/Problems: Evidence-Based Advances in NICU RBC Transfusion Practice

- Refinements/improvements in transfusion guidelines
- Using NIRS to assess potential candidates for RBC transfusion
- “Rejuvenation” of donor RBC for NICU transfusion
- Using cord blood (autologous or allogenic) for NICU transfusion
- Is the statistical association between *early* RBC transfusion and IVH “cause and effect”?
- Is the statistical association between *late* RBC transfusion and NEC “cause and effect”?

CONCLUSIONS (dynamic)



ANEMIA-PREVENTING STRATEGIES FOR VLBW NEONATES	CATEGORY OF EVIDENCE	CERTAINTY / MAGNITUDE / RECOMMENDATION
Delayed clamping of the umbilical cord	1A	High/Substantial/A
Milking the umbilical cord	1A	High/Substantial /A
Drawing initial blood tests from cord	2B	Moderate/Moderate /B
Limiting phlebotomy losses	1B	Moderate/Substantial /B
Erythropoietin/ Darbepoetin	1A	Moderate/Moderate /B Moderate/Small /C

Thank you.



*“Not all of us
can do great things. But
we can do small things
with great love.”*

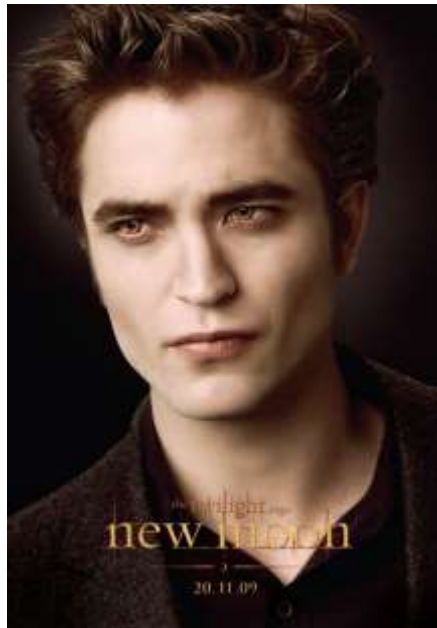
Mother Teresa

Questions

POST-TEST

Which one of the following is the most painful blood sucker?

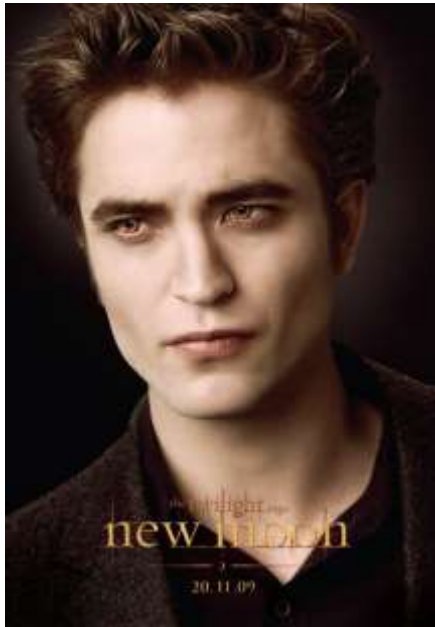
A.



POST-TEST

Which one of the following is the most painful blood sucker?

A.



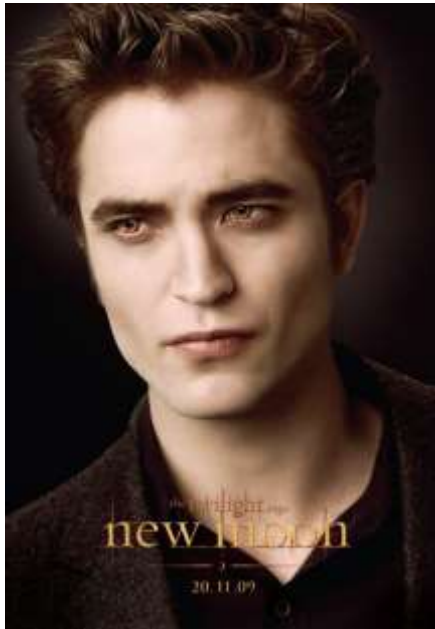
B.



POST-TEST

Which one of the following is the most painful blood sucker?

A.



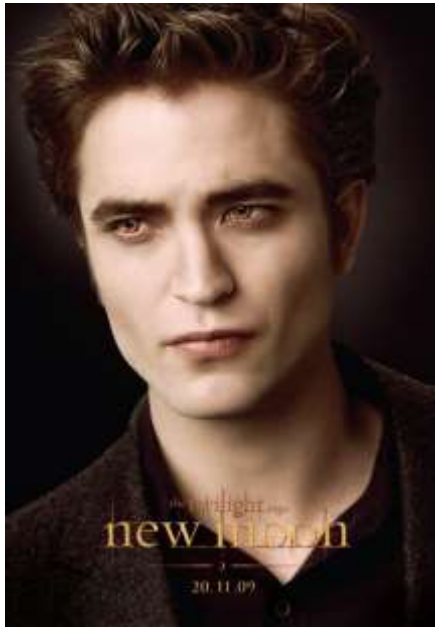
B. these topics C.



POST-TEST

Which one of the following is the most painful blood sucker?

A.



B.



C.



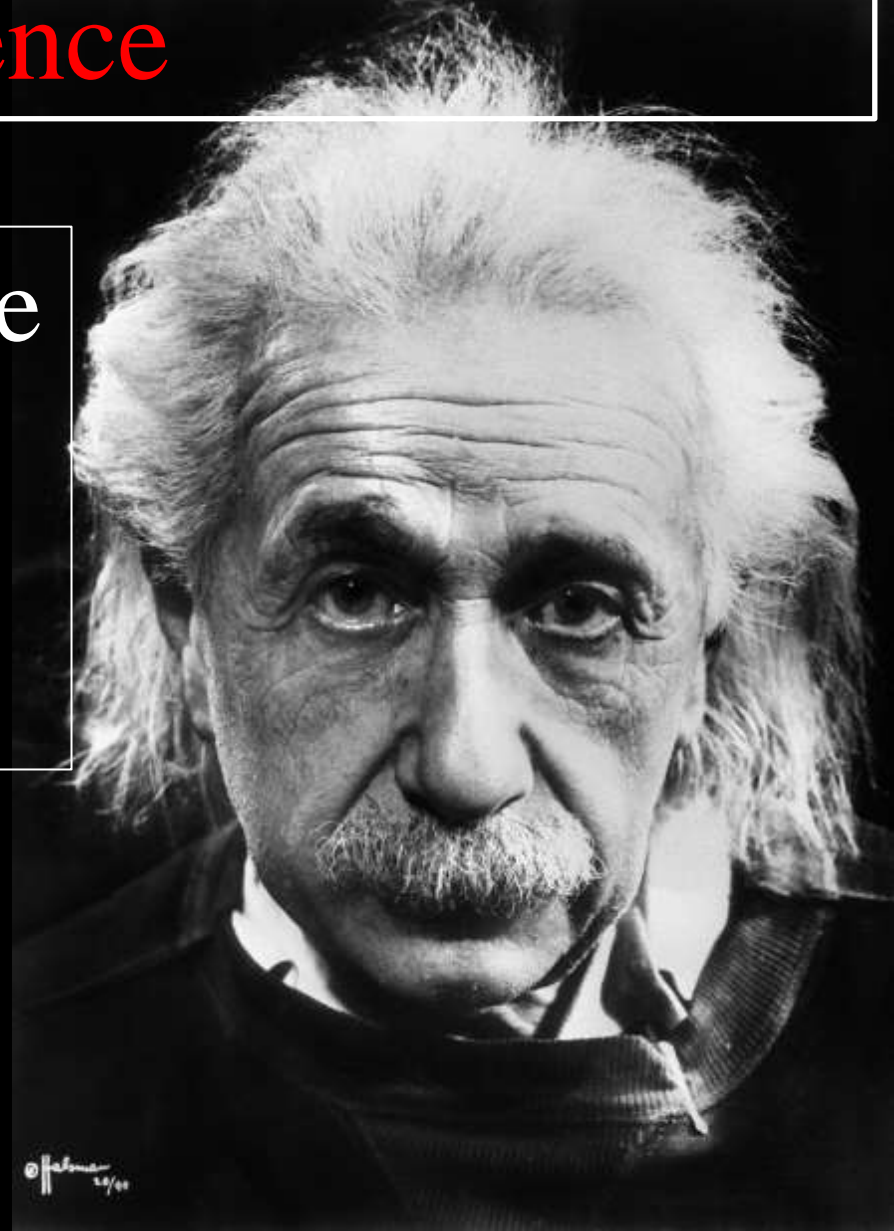
D.



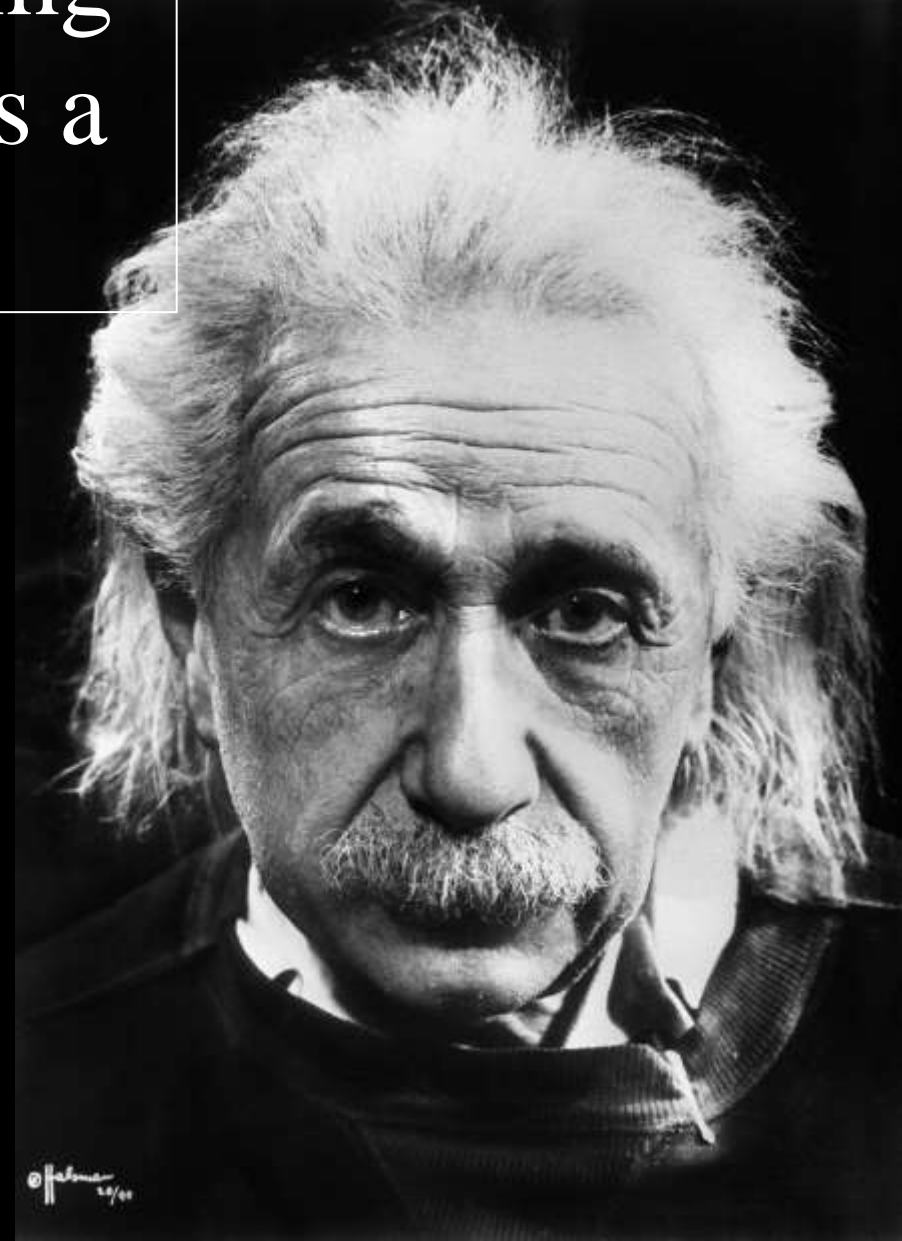
Department of the Treasury
Internal Revenue Service

A Parting Thought for the International Neonatology Conference

What is the difference
between
KNOWLEDGE and
WISDOM?



KNOWLEDGE is being
aware that a Tomato is a
fruit, not a vegetable.



WISDOM is not putting
a Tomato in a fruit salad.

